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March 2, 1999

Ms. Magalie Roman Salas, Esq.
Secretary
Federal Communications Commission
(Delivered to TW-A325, 12th Street lobby)
The Portals
445 Twelfth Street, SW
Washington, D.C. 20554

Re: ET Docket No. 98-206
RM-9147
RM-9245

Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range

and

Amendment of the Commission's Rules to Authorize Subsidiary Terrestrial Use of the 12.2-12.7 GHz Band by Direct Broadcast Satellite Licensees and Their Affiliates

Dear Ms. Salas:

Transmitted herewith by the National Academy of Sciences, through the Committee on Radio Frequencies of the National Research Council, are an original and 5 copies of its Comments in the above-referenced proceedings. If additional information is required concerning this matter, please communicate with this office.

Sincerely yours,

Robert L. Riemer

Robert L. Riemer
Senior Program Officer

cc: Members of CORF
Mr. Paul J. Feldman
Dr. Tomas Gergely
Dr. Donald C. Shapero

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Before the
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COMMENTS OF THE NATIONAL ACADEMY OF SCIENCES' COMMITTEE ON RADIO FREQUENCIES

The National Academy of Sciences, through the National Research Council's Committee on Radio Frequencies* (hereinafter, "CORF"), hereby submits its comments in response to the Commission's November 19, 1998, Notice of Proposed Rulemaking in the above-captioned docket ("NPRM"). In these comments, CORF demonstrates that it will be difficult for satellite space-to-Earth downlinks in the 10.7-12.7 GHz band to operate in a manner that does not cause harmful interference to radio astronomy observations in the 10.6-10.7 GHz band, in which the Radio Astronomy Service (RAS) has a primary allocation. Accordingly, if the Commission allocates use of this band for satellite space-to-Earth downlinks, it must require that such transmissions protect radio astronomy observations at the level required under ITU-R Recommendation RA.769-1. In addition, the Commission should also modify Part 25 of its Rules to provide for a stringent filtering requirement to assure that these levels are met. Such proposed modifications are necessary if radio astronomy observations in this band are to be protected in a meaningful manner.

*The committee membership roster is attached as Appendix A.

I. Introduction: The Importance of Radio Astronomy Observations in the 10.6-10.7 GHz Band and the Unique Vulnerability of Radio Astronomy to Out-of-Band and Spurious Emissions.

CORF has a substantial interest in this proceeding, because it represents the interests of the radio astronomy community, as well as those of other scientific users of the radio spectrum. As the Commission has long recognized, radio astronomy is a vitally important tool used by scientists to study our universe. Through the use of radio astronomy, scientists have in recent years discovered the first planets outside the solar system, circling a distant pulsar. Measurements of radio spectral line emission have identified and characterized the birth sites of stars in our own Galaxy and the complex distribution and evolution of galaxies in the universe. Radio astronomy measurements have discovered ripples in the cosmic microwave background, generated in the early universe, which later formed the stars and galaxies we know today. Observations of supernovas witness the creation and distribution of heavy elements essential to the formation of planets like Earth and of life itself. Furthermore, in addition to increasing knowledge of our world and the universe, radio astronomy has produced substantial benefits through the development of very-low-noise receivers and many other applications used in a variety of commercial and defense applications. In addition, the technique of very-long-baseline interferometry ("VLBI"), developed for cosmic observations, is increasingly producing substantial benefits through use in terrestrial observations, including measurements of global distances (e.g., identification of potential earthquake zones through measurement of fault motion), and through major contributions to navigation, including the tracking of spacecraft. These benefits of radio astronomy, obtained through years of work and substantial federal investment, as well as future benefits, must be protected.

As passive users of the spectrum, working at frequencies determined by the laws of nature, radio astronomers have no control over the frequencies that they need to study, or over the character of the "transmitted" signal. These parameters are set by the laws of nature. Furthermore, the emissions that radio astronomers receive are extremely weak—a typical radio telescope receives only about one-trillionth of a watt from even the strongest cosmic source. Because radio astronomy receivers are designed to detect such remarkably weak signals, its facilities are therefore particularly vulnerable to interference from spurious and out-of-band emissions from licensed and unlicensed users of neighboring bands, and those that produce harmonic emissions that fall in the RAS bands.

Of particular concern in this proceeding is interference to radio astronomy observations in the 10.6-10.7 GHz band from non-geostationary satellite orbit (NGSO) gateway downlinks in the 10.7-11.7 GHz band. The 10.68-10.70 GHz band is allocated on a primary basis to the RAS and the 10.60-10.68 GHz band is allocated to the RAS on a co-primary basis.[†] There is a reason for these primary allocations: the 10.6-10.7 GHz

[†]Observations in these bands are made at radio astronomy observatories in Goldstone, California; Green Bank, West Virginia; Socorro, New Mexico; St Croix, Virgin Islands;

band is especially important to both the Radio Astronomy and the Earth Remote Sensing Services because it provides a substantial bandwidth (nearly 1%) at a wavelength that is still long enough that Earth's atmosphere does not produce substantial opacity. This makes possible the most sensitive continuum measurements, which are required for the passive services. Detailed measurements of the cosmic background are conducted in this frequency band, as are passive radiometric measurements of the sea state and wind directions over oceans, which are extremely important in tracking hurricanes and protecting maritime activities.

In summary, radio astronomy and passive Earth remote sensing observations in the 10.6-10.7 GHz band are very important, yet like all radio astronomy observations, are uniquely vulnerable to interference from out-of-band and spurious emissions.

II. It Will Be Difficult to Operate Gateway Downlinks in the 10.7-11.7 GHz Band While Complying with the Required Emission Limits.

As the Commission correctly points out in Paragraph 82 of the Notice, in order to comply with the requirements of ITU-R RA.769-1, NGSO transmitters would have to limit out-of-band emissions in these frequency ranges in order to maintain ground levels at or below –255 dBW/m^2/Hz when they are within 5 degrees of the main beam of the radio telescopes, and levels at or below –240 dBW/m^2/Hz at all other times. This is especially challenging since the flux densities in the downlink band are on the order of –206 dBW/m^2/Hz. Moreover, although the NGSO petitioners such as SkyBridge might suggest that they can avoid interference by shutting off transmission when in the beams of radio telescopes, the apparent necessity that the gateway stations be removed from major cities in order to avoid interference to the heavily used terrestrial fixed services and the requirement that NGSO spaceborne transmitters protect the GSO arcs of avoidance, strongly suggest that the likelihood of success of such an approach is minimal.

As a general matter, historically the placement of satellite downlink allocations immediately adjacent to RAS and other passive allocations has often resulted in harmful interference to, and loss of flexibility and scientific yield from, large numbers of radio astronomical facilities. Therefore, given the high likelihood that without mandatory prohibitions, the operation of NGSO gateway downlinks will cause harmful interference to important RAS observations in the 10.6-10.7 GHz bands, CORF strongly recommends that the Commission explicitly mandate that a condition of the licensing of such downlink operations be protection of RAS observations in the 10.6-10.7 GHz band at the levels proposed in paragraph 82 of the Notice. Additionally, the Commission should

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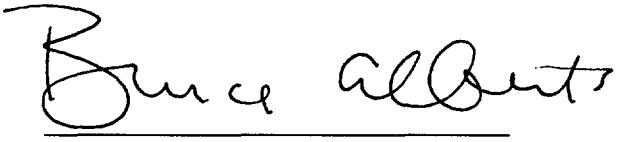
Hancock, New Hampshire; North Liberty, Iowa; Fort Davis, Texas; Los Alamos, New Mexico; Pie Town, New Mexico; Kitt Peak, Arizona; Owens Valley, California; Brewster, Washington; Mauna Kea, Hawaii; Amherst, Massachusetts; Hat Creek, California; Westford, Massachusetts; and numerous other observatories in other countries. Most of these sites are outside of the exclusion zones proposed in Appendix C of the Notice.

consider a further reduction (by 10 dB) in the maximum flux densities allowed for gateway downlinks between 10.7 and 11.2 GHz (i.e., the subband closest to the passive allocation) below the values given in Table 1 of the Notice in order to assure the technical feasibility of achieving the protection levels proposed in paragraph 82 of the Notice. Furthermore, the Commission should modify Part 25 of its Rules to require that NGSO satellite station transmissions down to gateways use filters that can provide at least 50 dB of suppression in an adjacent band. While these requirements would cause some increase in the cost of gateway Earth stations and/or satellite stations, they constitute a less risky approach for assuring compatibility of the gateway downlinks with both adjacent band radio astronomy users and in-band fixed service users.

III. Conclusion

If the Commission decides to allocate use of the 10.7-11.7 GHz band to satellite gateway downlink operations, it must require that such transmissions protect radio astronomy observations at the levels set forth in paragraph 82 of the Notice, as required under ITU-R RA.769-1. In addition, the Commission should also modify Part 25 of its Rules to provide for a stringent filtering requirement to assure that these levels are met. Such proposed modifications are necessary if radio astronomy observations in the adjacent band are to be protected in a meaningful manner.

Respectfully submitted,
NATIONAL ACADEMY OF SCIENCES'
COMMITTEE ON RADIO FREQUENCIES

By: 

Bruce Alberts
President

March 2, 1999

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